

# Si/SiC Hybrid Module – EliteSiC, 3 Channel Symmetric Boost 1000 V, 200 A IGBT, 1200 V, 60 A SiC Diode, Q2 Package

**NXH600B100H4Q2F2PG,  
NXH600B100H4Q2F2SG,  
NXH600B100H4Q2F2SG-R**

The NXH600B100H4Q2 is a Si/SiC Hybrid three channel symmetric boost module. Each channel contains two 1000 V, 200 A IGBTs, and two 1200 V, 60 A SiC diodes. The module contains an NTC thermistor.

## Features

- Extremely Efficient Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Module Design Offers High Power Density
- Low Inductive Layout
- Low Package Height
- Pb-Free, Halogen Free/BFR Free and RoHS Compliant

## Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies Systems

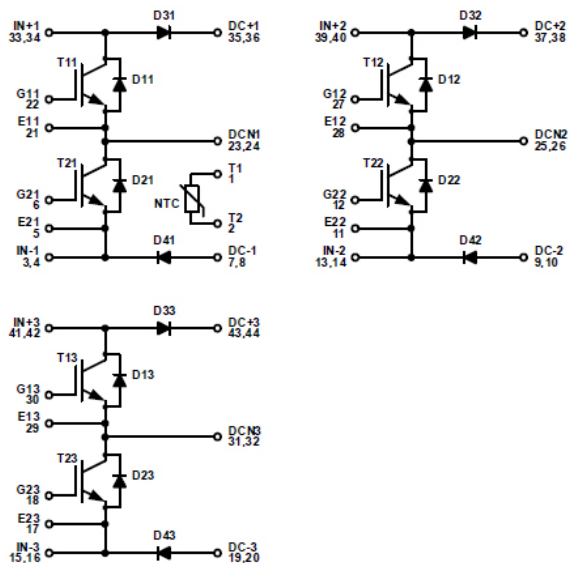
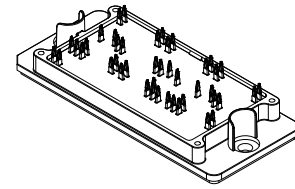
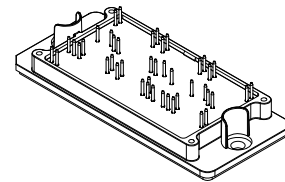


Figure 1. NXH600B100H4Q2F2 Schematic Diagram

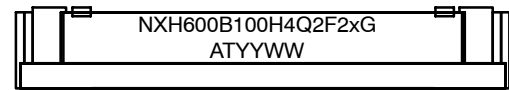


PIM44, 93x47 (PRESS FIT)  
CASE 180HF



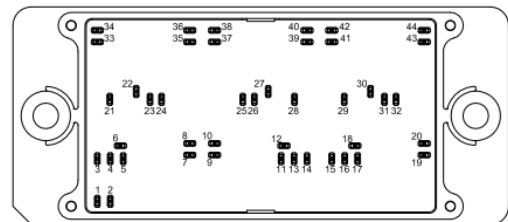
PIM44, 93x47 (SOLDER PIN)  
CASE 180HE

## MARKING DIAGRAM



NXH600B100H4Q2F2xG = Device Code  
X = P or S  
G = Pb-Free Package  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code

## PIN CONNECTIONS



## ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

# NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

## ABSOLUTE MAXIMUM RATINGS (Note 1) $T_J = 25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Value	Unit
<b>IGBT (T11, T21, T12, T22, T13, T23)</b>			
Collector-Emitter Voltage	$V_{CES}$	1000	V
Gate-Emitter Voltage Positive Transient Gate – Emitter Voltage (tpulse = 5 $\mu\text{s}$ , $D < 0.10$ )	$V_{GE}$	$\pm 20$ 30	V
Continuous Collector Current @ $T_c = 80^{\circ}\text{C}$	$I_C$	192	A
Pulsed Peak Collector Current @ $T_c = 80^{\circ}\text{C}$ ( $T_J = 175^{\circ}\text{C}$ )	$I_{C(Pulse)}$	576	A
Maximum Power Dissipation ( $T_J = 175^{\circ}\text{C}$ )	$P_{tot}$	511	W
Minimum Operating Junction Temperature	$T_{JMIN}$	-40	$^{\circ}\text{C}$
Maximum Operating Junction Temperature (Note 2)	$T_{JMAX}$	175	$^{\circ}\text{C}$

## IGBT INVERSE DIODE (D11, D21, D12, D22, D13, D23)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_c = 80^{\circ}\text{C}$	$I_F$	66	A
Repetitive Peak Forward Current ( $T_J = 175^{\circ}\text{C}$ )	$I_{FRM}$	198	A
Maximum Power Dissipation ( $T_J = 175^{\circ}\text{C}$ )	$P_{tot}$	101	W
Minimum Operating Junction Temperature	$T_{JMIN}$	-40	$^{\circ}\text{C}$
Maximum Operating Junction Temperature	$T_{JMAX}$	175	$^{\circ}\text{C}$

## SILICON CARBIDE SCHOTTKY DIODE (D31, D41, D32, D42, D33, D43)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_c = 80^{\circ}\text{C}$	$I_F$	73	A
Repetitive Peak Forward Current ( $T_J = 175^{\circ}\text{C}$ )	$I_{FRM}$	219	A
Maximum Power Dissipation ( $T_J = 175^{\circ}\text{C}$ )	$P_{tot}$	217	W
Minimum Operating Junction Temperature	$T_{JMIN}$	-40	$^{\circ}\text{C}$
Maximum Operating Junction Temperature	$T_{JMAX}$	175	$^{\circ}\text{C}$

## THERMAL PROPERTIES

Operating Temperature under Switching Condition	$T_{VJOP}$	-40 to 150	$^{\circ}\text{C}$
Storage Temperature Range	$T_{stg}$	-40 to 125	$^{\circ}\text{C}$

## INSULATION PROPERTIES

Isolation Test Voltage, $t = 1 \text{ s}$ , 50 Hz	$V_{is}$	4000	$V_{RMS}$
Creepage Distance		12.7	mm
Comparative Tracking Index	CTI	>600	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.
2. Qualification at  $175^{\circ}\text{C}$  per discrete TO247.

# NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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### IGBT (T11, T21, T12, T22, T13, T23) CHARACTERISTICS

Collector-Emitter Breakdown Voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	V <sub>(BR)CES</sub>	1000	1165	—	V
Collector-Emitter Cutoff Current	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1000V	I <sub>CES</sub>	—	—	10	μA
Collector-Emitter Saturation Voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 200 A, T <sub>J</sub> = 25°C	V <sub>CE(sat)</sub>	—	1.69	2.3	V
	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 200 A, T <sub>J</sub> = 175°C		—	2.15	—	
Gate-Emitter Threshold Voltage	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 200 mA	V <sub>GE(TH)</sub>	3.8	4.75	6.6	V
Gate Leakage Current	V <sub>GE</sub> = ±20 V, V <sub>CE</sub> = 0 V	I <sub>GES</sub>	—	—	±1	μA
Internal Gate Resistor		r <sub>g</sub>	—	2	—	Ω
Turn-on Delay Time	T <sub>J</sub> = 25°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50A V <sub>GE</sub> = -9 V, 15 V, R <sub>gon</sub> = 6 Ω, R <sub>goff</sub> = 6 Ω	t <sub>d(on)</sub>	—	111	—	ns
Rise Time		t <sub>r</sub>	—	15	—	
Turn-off Delay Time		t <sub>d(off)</sub>	—	338	—	
Fall Time		t <sub>f</sub>	—	113	—	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	—	460	—	μJ
Turn off Switching Loss per Pulse		E <sub>off</sub>	—	1930	—	
Turn-on Delay Time	T <sub>J</sub> = 125°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = -9 V, 15 V, R <sub>gon</sub> = 6 Ω, R <sub>goff</sub> = 6 Ω	t <sub>d(on)</sub>	—	111	—	ns
Rise Time		t <sub>r</sub>	—	17	—	
Turn-off Delay Time		t <sub>d(off)</sub>	—	406	—	
Fall Time		t <sub>f</sub>	—	142	—	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	—	660	—	μJ
Turn off Switching Loss per Pulse		E <sub>off</sub>	—	2860	—	
Input Capacitance	V <sub>CE</sub> = 20 V, V <sub>GE</sub> = 0 V, f = 1 MHz	C <sub>ies</sub>	—	13256	—	pF
Output Capacitance		C <sub>oes</sub>	—	456	—	
Reverse Transfer Capacitance		C <sub>res</sub>	—	78	—	
Total Gate Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = -15V~15 V	Q <sub>g</sub>	—	766	—	nC
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.87 W/mK	R <sub>thJH</sub>	—	0.45	—	K/W
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	—	0.186	—	K/W

### IGBT INVERSE DIODE (D11, D21, D12, D22, D13, D23) CHARACTERISTICS

Diode Forward Voltage	I <sub>F</sub> = 50 A, T <sub>J</sub> = 25 °C	V <sub>F</sub>	—	1.10	1.55	V
	I <sub>F</sub> = 50 A, T <sub>J</sub> = 175 °C		—	0.975	—	
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.87 W/mK	R <sub>thJH</sub>	—	0.98	—	K/W
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	—	0.65	—	K/W

### DIODES (D31, D41, D32, D42, D33, D43) CHARACTERISTICS

Diode Forward Voltage	I <sub>F</sub> = 60 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	—	1.54	1.85	V
	I <sub>F</sub> = 60 A, T <sub>J</sub> = 175°C		—	2.27	—	
Reverse Recovery Time	T <sub>J</sub> = 25°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = -9 V, 15 V, R <sub>gon</sub> = 6 Ω	t <sub>rr</sub>	—	13	—	ns
Reverse Recovery Charge		Q <sub>rr</sub>	—	93	—	nC
Peak Reverse Recovery Current		I <sub>RRM</sub>	—	11	—	A
Peak Rate of Fall of Recovery Current		di/dt	—	2767	—	A/μs
Reverse Recovery Energy		E <sub>rr</sub>	—	45	—	μJ

# NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 600\text{ V}$ , $I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}$ , $15\text{ V}$ , $R_{gon} = 6\ \Omega$	$t_{rr}$	—	12	—	ns
Reverse Recovery Charge		$Q_{rr}$	—	90	—	nC
Peak Reverse Recovery Current		$I_{RRM}$	—	11	—	A
Peak Rate of Fall of Recovery Current		$di/dt$	—	2287	—	A/ $\mu\text{s}$
Reverse Recovery Energy		$E_{rr}$	—	32	—	$\mu\text{J}$
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.87\text{ W/mK}$	$R_{thJH}$	—	0.68	—	K/W
Thermal Resistance – Chip-to-Case		$R_{thJC}$	—	0.438	—	K/W

## THERMISTOR CHARACTERISTICS

Nominal Resistance	$T = 25^\circ\text{C}$	$R_{25}$	—	22	—	k $\Omega$
Nominal Resistance	$T = 100^\circ\text{C}$	$R_{100}$	—	1504	—	$\Omega$
Deviation of R25		$\Delta R/R$	-1	—	1	%
Power Dissipation		$P_D$	—	187.5	—	mW
Power Dissipation Constant			—	1.5	—	mW/K
B-value	B (25/100), tolerance $\pm 1\%$		—	3980	—	K

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND BOOST DIODE

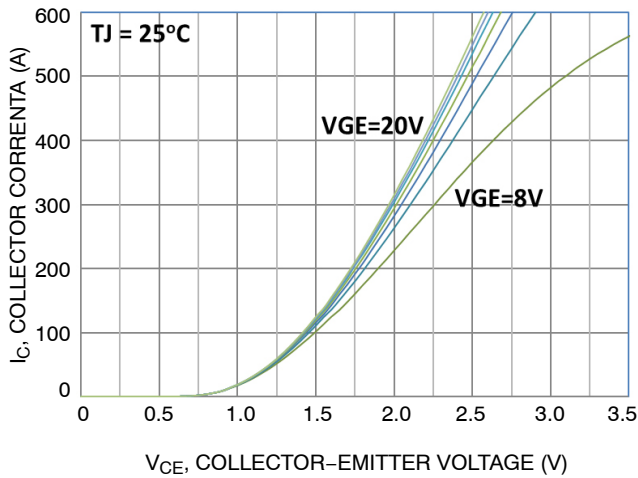


Figure 2. Typical Output Characteristics

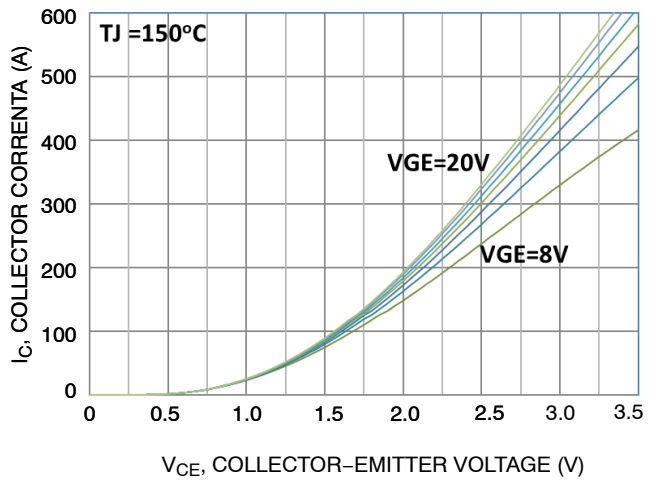


Figure 3. Typical Output Characteristics

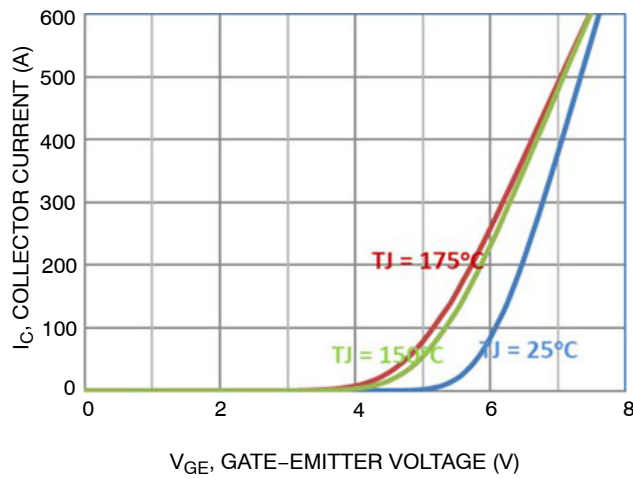


Figure 4. Transfer Characteristics

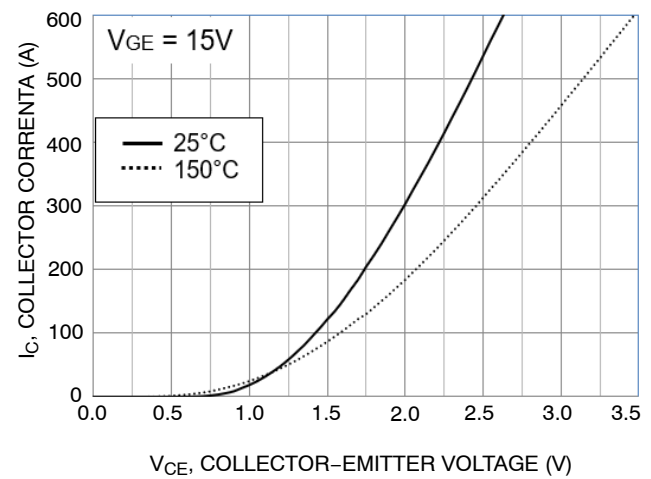


Figure 5. Saturation Voltage Characteristic

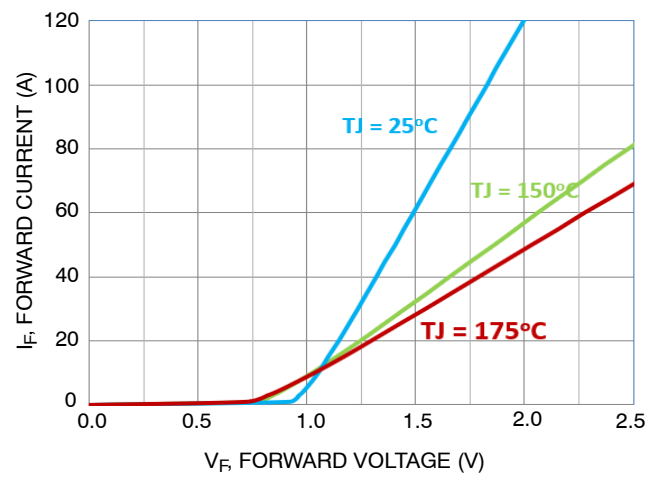


Figure 6. Boost Diode Forward Characteristics

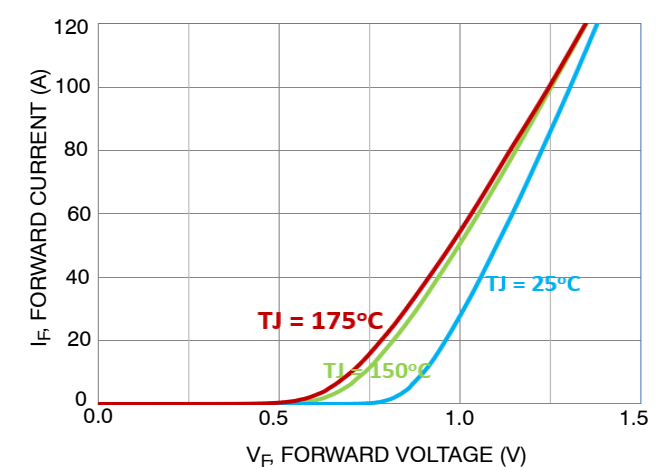


Figure 7. Inverse Diode Forward Characteristics

TYPICAL CHARACTERISTICS – IGBT AND BOOST DIODE

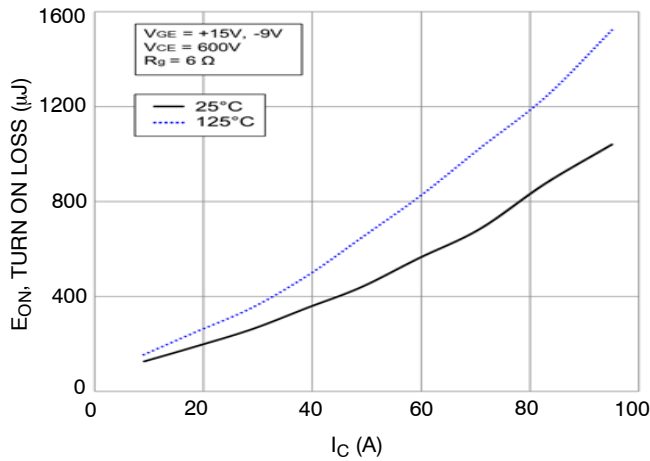


Figure 8. Typical Turn On Loss vs. IC

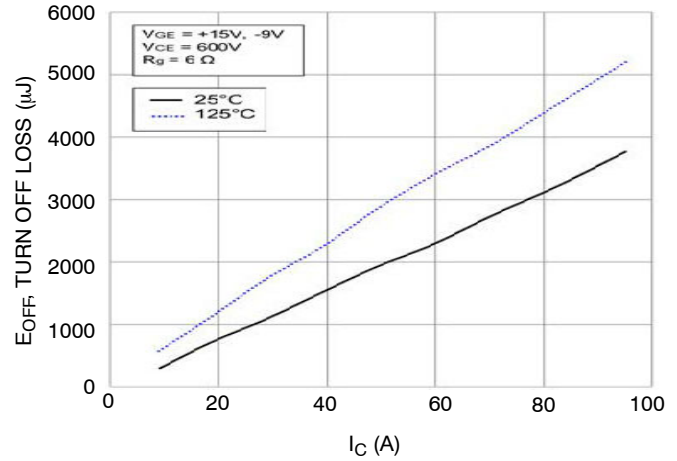


Figure 9. Typical Turn Off Loss vs. IC

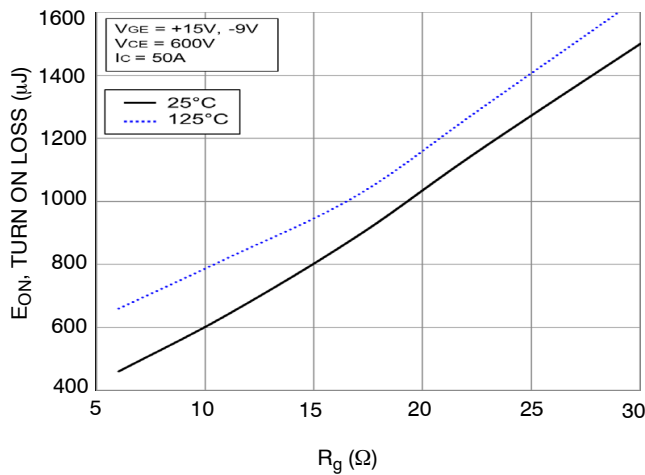


Figure 10. Typical Turn On Loss vs. Rg

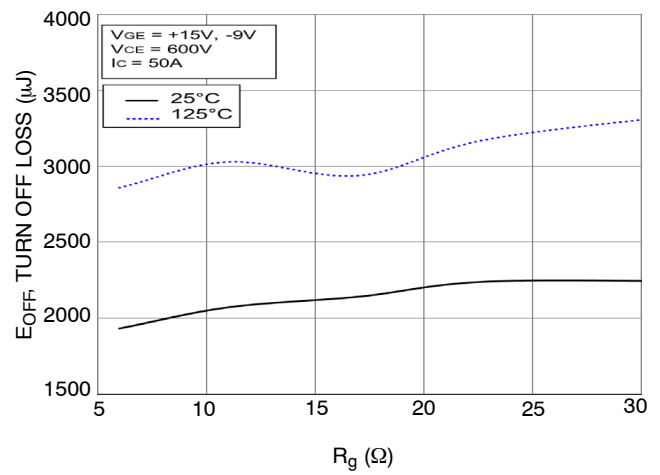


Figure 11. Typical Turn Off Loss vs. Rg

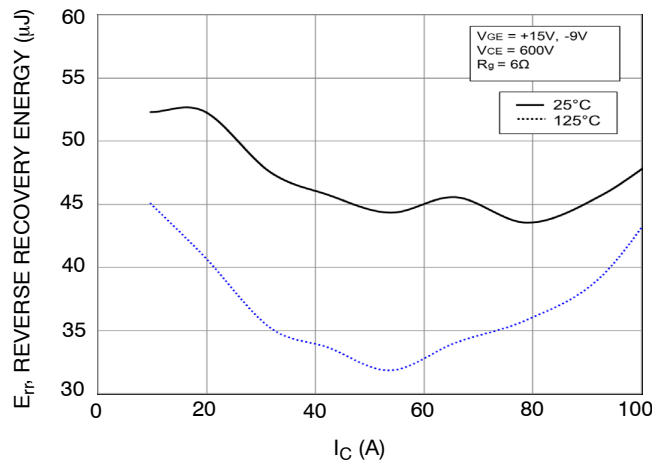


Figure 12. Typical Reverse Recovery Energy Loss vs. IC

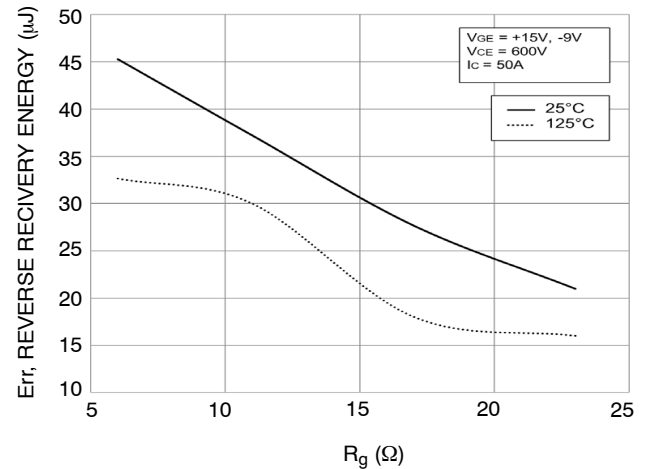


Figure 13. Typical Reverse Recovery Energy Loss vs. Rg

Typical Characteristics – IGBT and Boost Diode (CONTINUED)

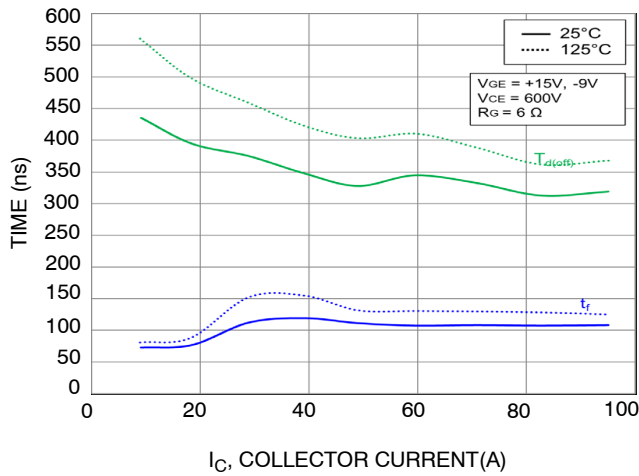


Figure 14. Typical Turn-Off Switching Time vs.  $I_C$

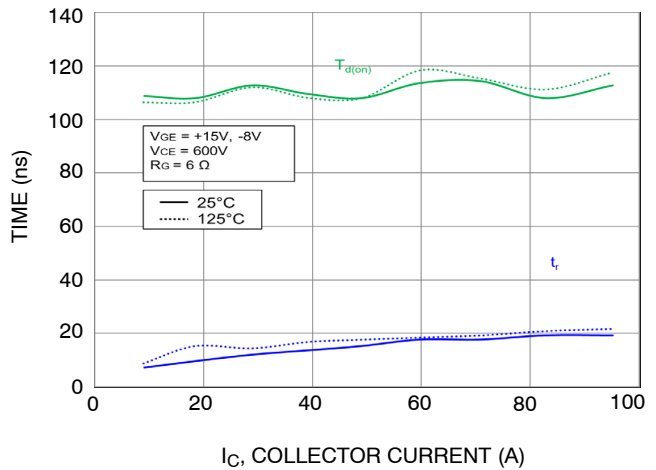


Figure 15. Typical Turn-On Switching Time vs.  $I_C$

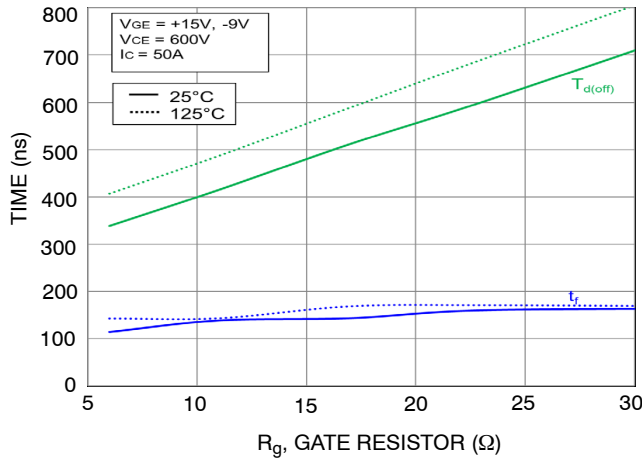


Figure 16. Typical Turn-Off Switching Time vs.  $R_g$

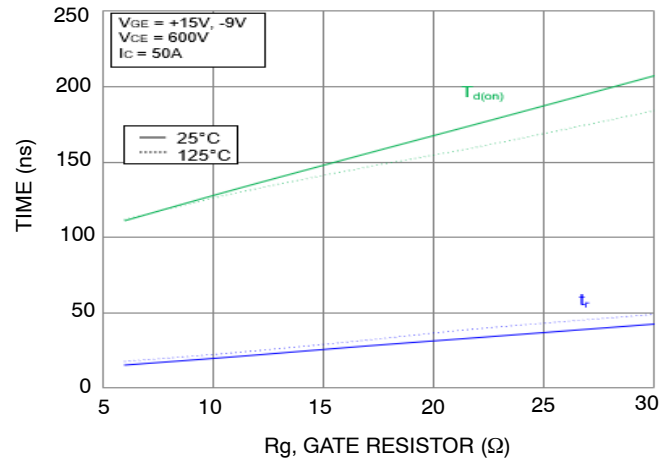


Figure 17. Typical Turn-On Switching Time vs.  $R_g$

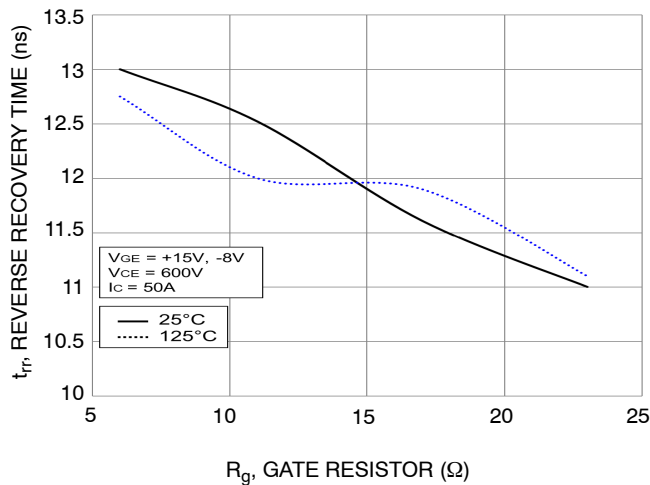


Figure 18. Typical Reverse Recovery Time vs.  $R_g$

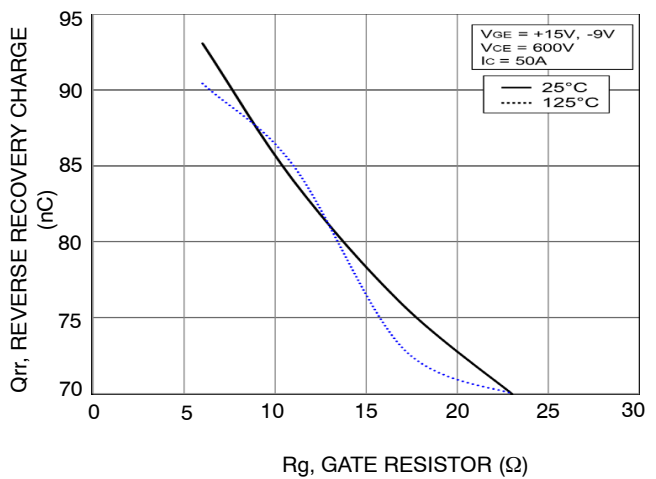


Figure 19. Typical Reverse Recovery Charge vs.  $R_g$

Typical Characteristics – IGBT and Boost Diode (CONTINUED)

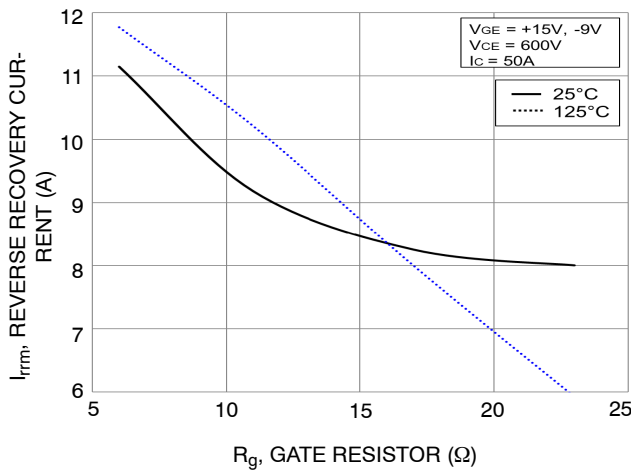


Figure 20. Typical Reverse Recovery Peak Current vs.  $R_g$

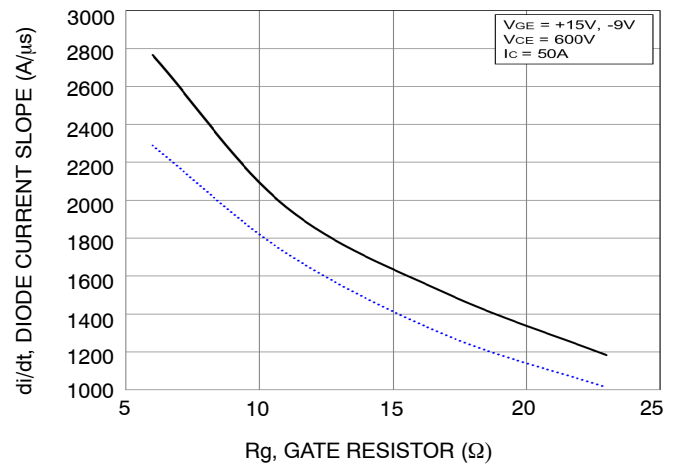


Figure 21. Typical di/dt vs.  $R_g$

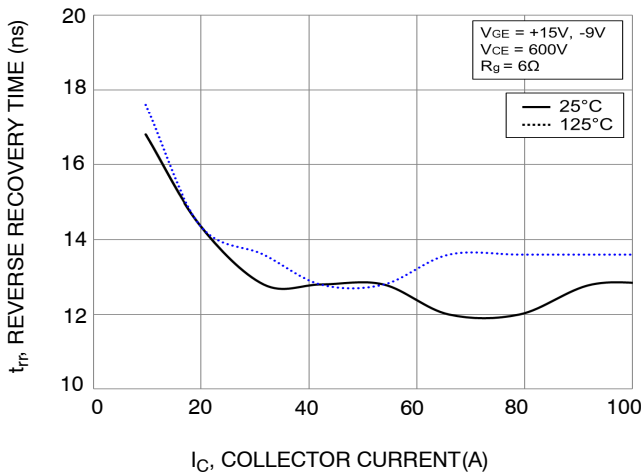


Figure 22. Typical Reverse Recovery Time vs.  $I_C$

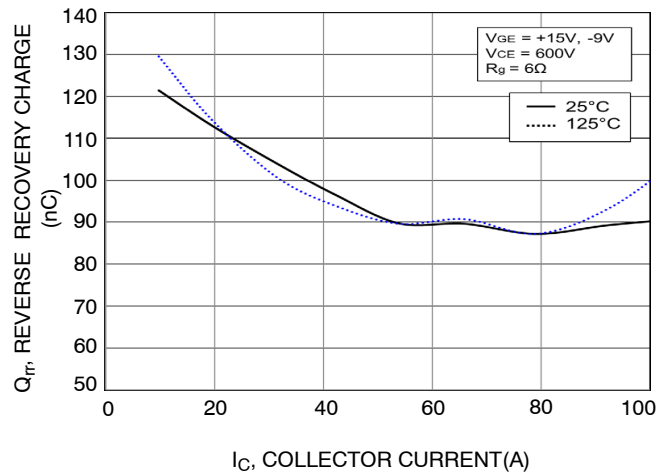


Figure 23. Typical Reverse Recovery Charge vs.  $I_C$

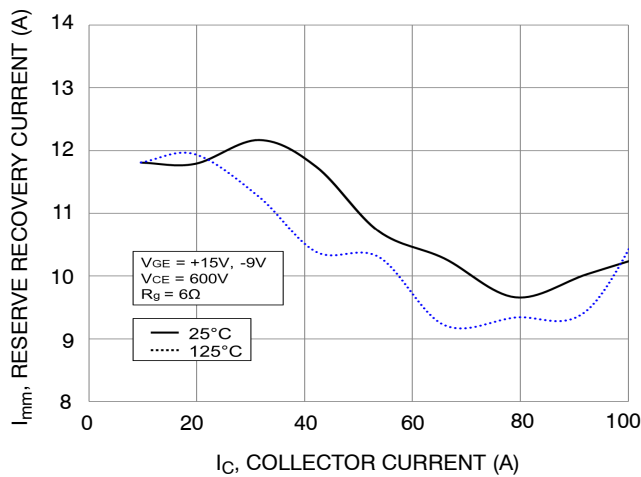


Figure 24. Typical Reserve Recovery Current vs.  $I_C$

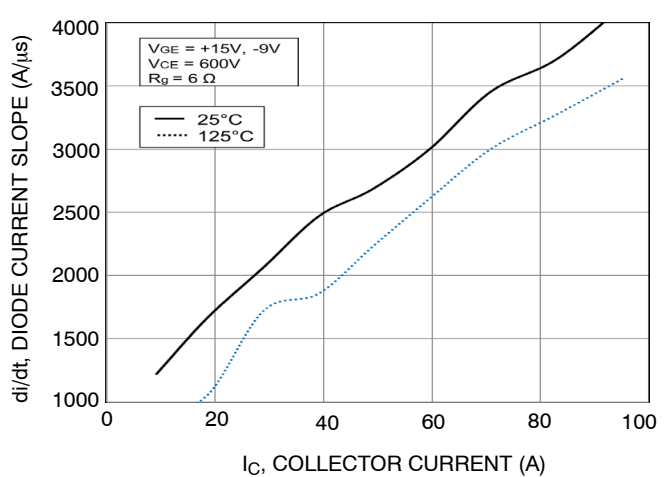


Figure 25. Typical di/dt vs.  $I_C$



TYPICAL CHARACTERISTICS – IGBT

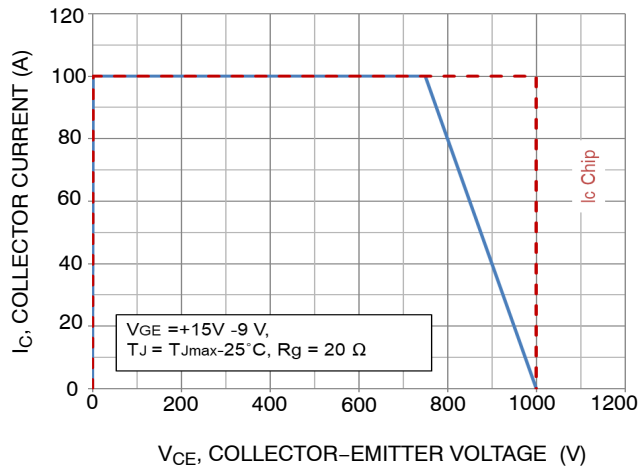


Figure 26. RBSOA

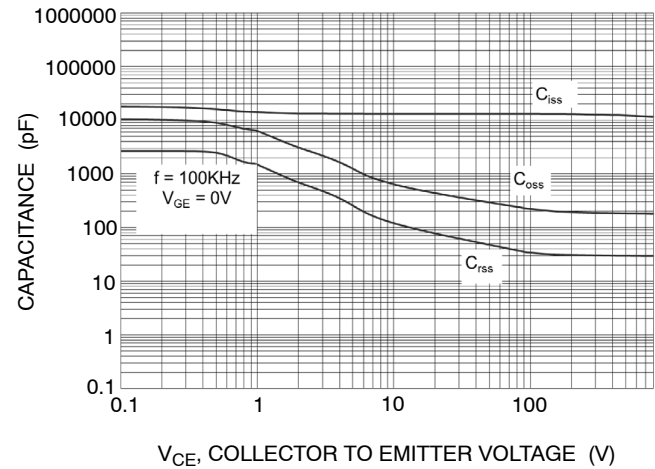


Figure 27. Capacitance Charge

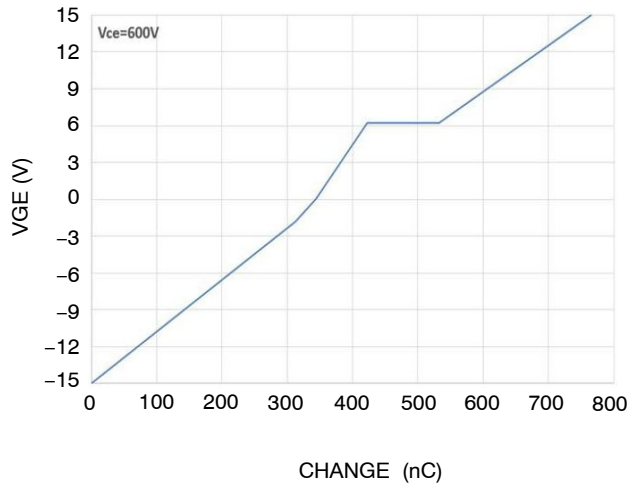


Figure 28. Gate Voltage vs. Gate Charge

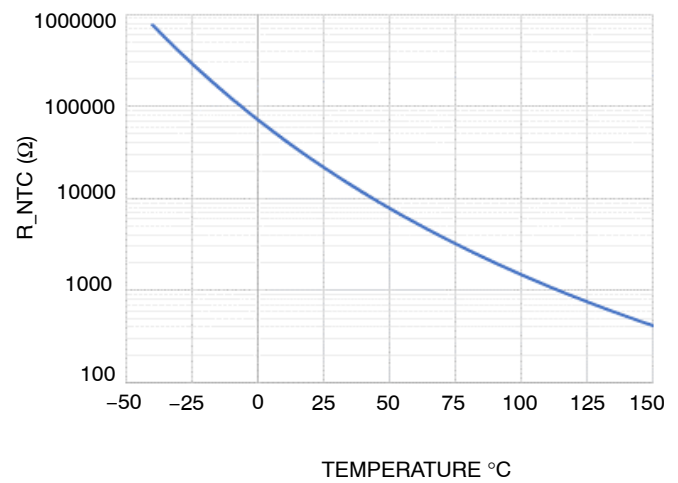


Figure 29. Temperature vs NTC Value

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND BOOST DIODE

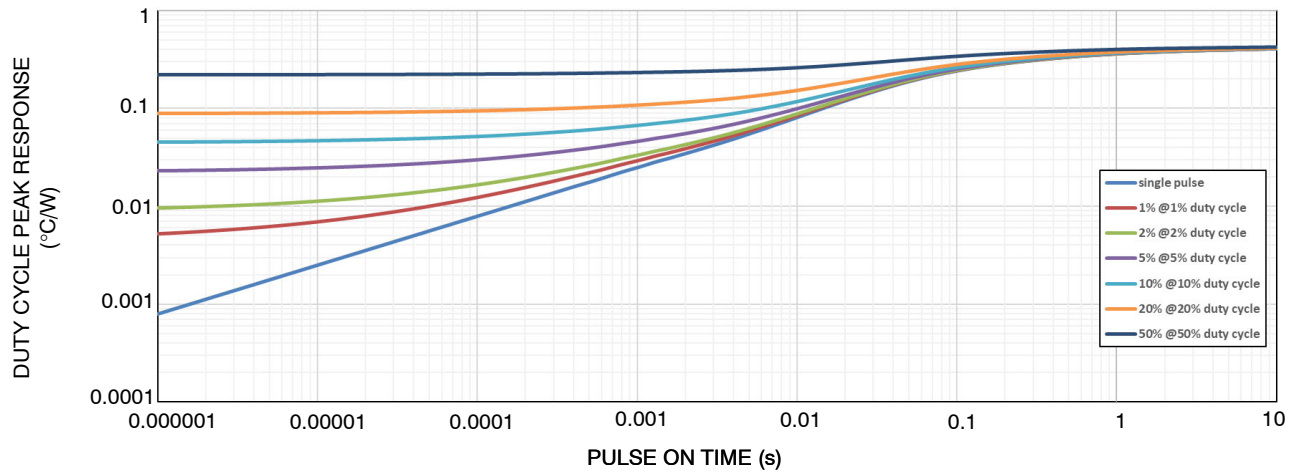


Figure 30. Transient Thermal Impedance (IGBT)

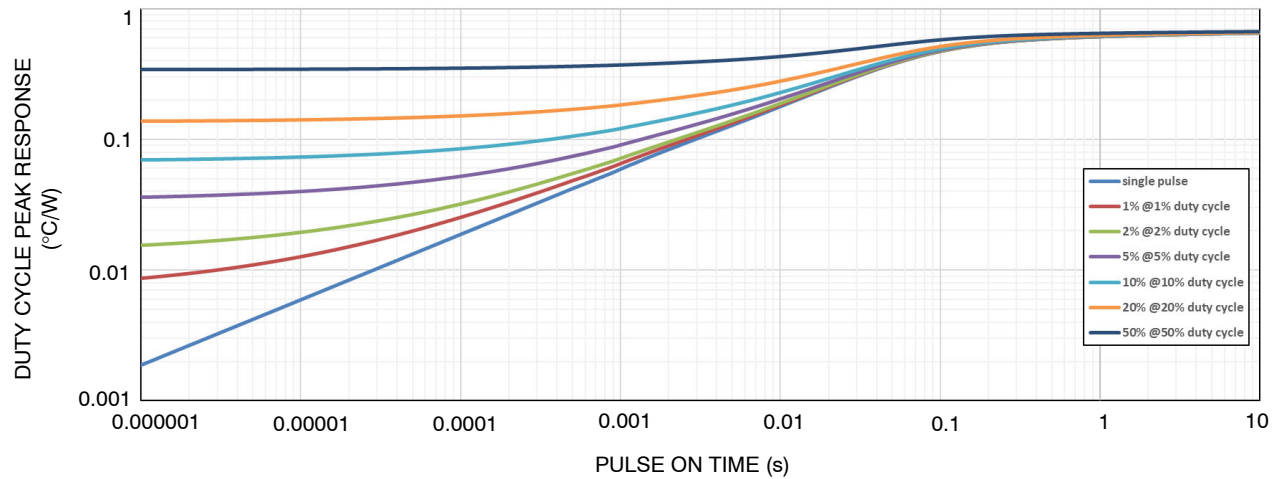


Figure 31. Transient Thermal Impedance (BOOST DIODE)

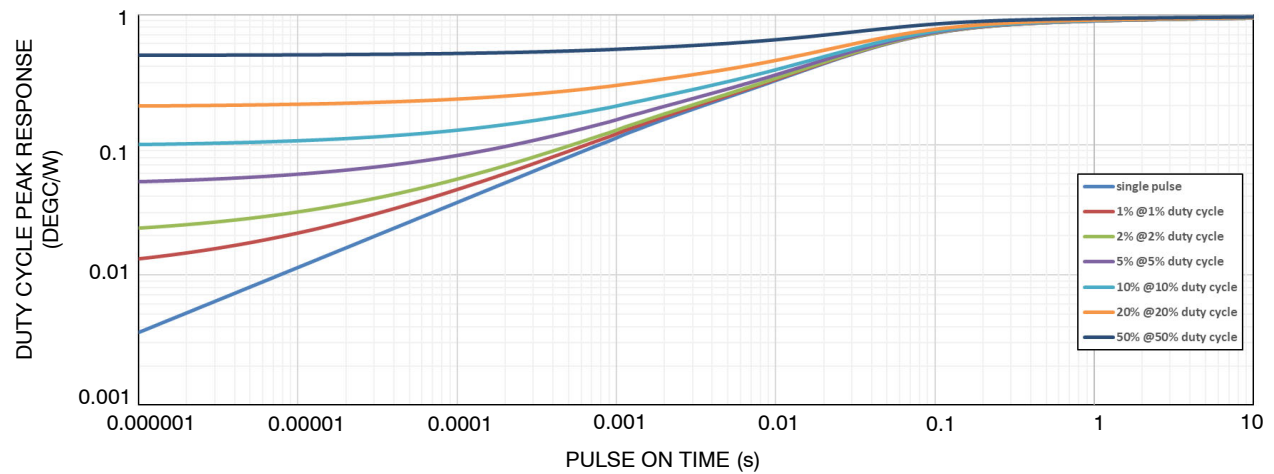


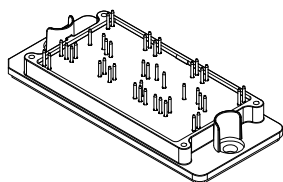
Figure 32. Transient Thermal Impedance (INVERSE DIODE)

# NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

## ORDERING INFORMATION

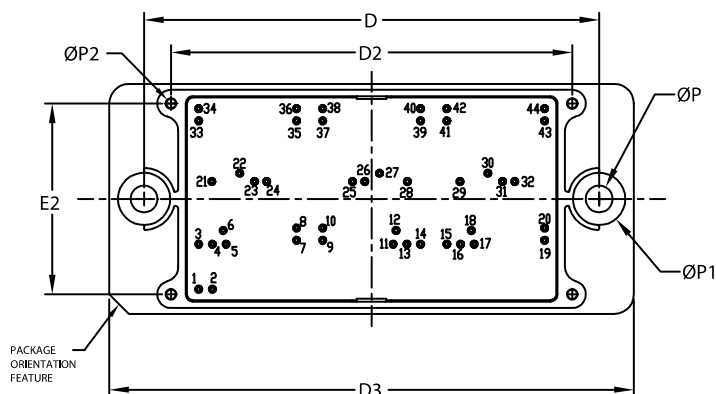
Device Order Number	Marking	Package	Shipping
NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R	NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R	Q2BOOST – Case 180HE (Pb-Free and Halide-Free Solder Pins)	12 Units / Blister Tray
NXH600B100H4Q2F2PG	NXH600B100H4Q2F2PG	Q2BOOST – Case 180HF (Pb-Free and Halide-Free Press Fit Pins)	12 Units / Blister Tray

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

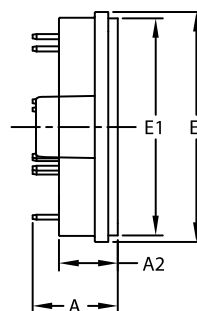


**PIM44, 93x47 (SOLDER PIN)**  
**CASE 180HE**  
**ISSUE O**

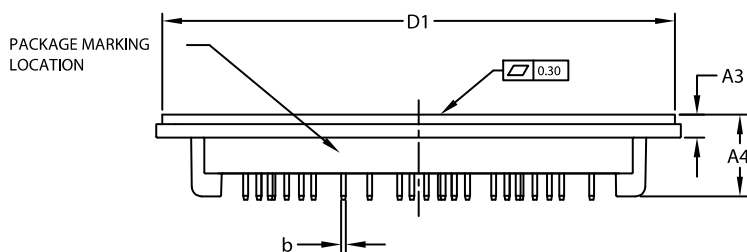
DATE 21 OCT 2021



TOP VIEW



END VIEW



SIDE VIEW

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009
2. CONTROLLING DIMENSION : MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A1
4. PIN POSITION TOLERANCE IS  $\pm 0.4\text{mm}$
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	17.00	17.40	17.80
A2	11.70	12.00	12.30
A3	4.40	4.70	5.00
A4	16.40	16.70	17.00
b	0.95	1.00	1.05
D	92.90	93.00	93.10
D1	104.45	104.75	105.05
D2	81.80	82.00	82.20
D3	106.90	107.20	107.50
E	46.70	47.00	47.30
E1	44.10	44.40	44.70
E2	38.80	39.00	39.20
P	5.40	5.50	5.60
P1	10.60	10.70	10.80
P2	1.80	2.00	2.20

## NOTE 4

PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
1	0.00	0.00	23	11.40	22.00
2	2.80	0.00	24	13.90	22.00
3	0.00	9.20	25	31.45	22.00
4	2.80	9.20	26	33.95	22.00
5	5.60	9.20	27	36.95	23.70
6	5.00	12.00	28	42.65	22.00
7	20.00	10.00	29	53.40	22.00
8	20.00	12.50	30	59.10	23.70
9	25.35	10.00	31	62.10	22.00
10	25.35	12.50	32	64.60	22.00
11	39.75	9.20	33	0.00	34.40
12	40.35	12.00	34	0.00	36.90
13	42.55	9.20	35	20.00	34.40
14	45.35	9.20	36	20.00	36.90
15	50.70	9.20	37	25.35	34.40
16	53.50	9.20	38	25.35	36.90
17	56.30	9.20	39	45.35	34.40
18	55.70	12.00	40	45.35	36.90
19	70.70	10.00	41	50.70	34.40
20	70.70	12.50	42	50.70	36.90
21	2.70	22.00	43	70.70	34.40
22	8.40	23.70	44	70.70	36.90

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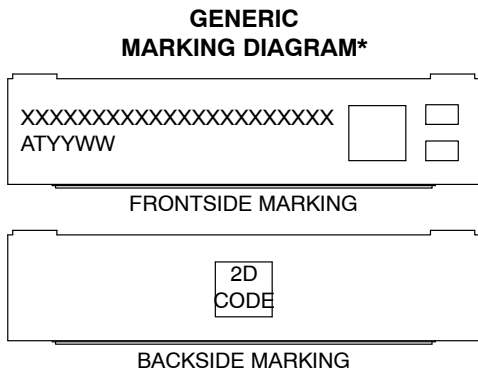
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

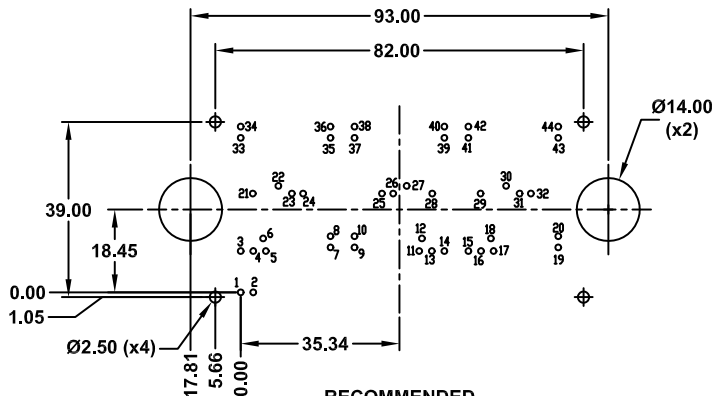


PIM44, 93x47 (SOLDER PIN)  
CASE 180HE  
ISSUE O

DATE 21 OCT 2021



XXXXXX = Specific Device Code  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code



\* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

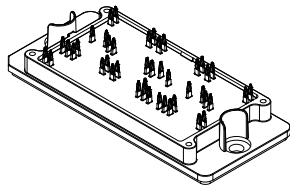
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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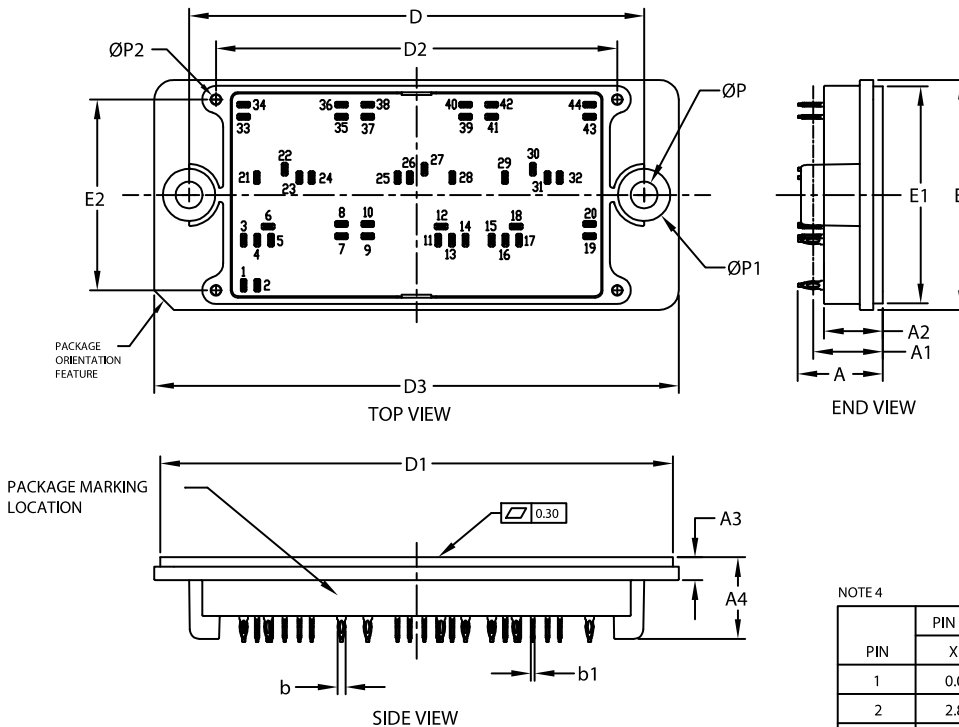
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**PIM44, 93x47 (PRESS FIT)**  
**CASE 180HF**  
**ISSUE O**

DATE 26 OCT 2021



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009
2. CONTROLLING DIMENSION : MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A1
4. PIN POSITION TOLERANCE IS  $\pm 0.4\text{mm}$
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	16.90	17.30	17.70
A1	14.18(REF)		
A2	11.70	12.00	12.30
A3	4.40	4.70	5.00
A4	16.40	16.70	17.00
b	1.61	1.66	1.71
b1	0.75	0.80	0.85
D	92.90	93.00	93.10
D1	104.45	104.75	105.05
D2	81.80	82.00	82.20
D3	106.90	107.20	107.50
E	46.70	47.00	47.30
E1	44.10	44.40	44.70
E2	38.80	39.00	39.20
P	5.40	5.50	5.60
P1	10.60	10.70	10.80
P2	1.80	2.00	2.20

## NOTE 4

PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
1	0.00	0.00	23	11.40	22.00
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3	0.00	9.20	25	31.45	22.00
4	2.80	9.20	26	33.95	22.00
5	5.60	9.20	27	36.95	23.70
6	5.00	12.00	28	42.65	22.00
7	20.00	10.00	29	53.40	22.00
8	20.00	12.50	30	59.10	23.70
9	25.35	10.00	31	62.10	22.00
10	25.35	12.50	32	64.60	22.00
11	39.75	9.20	33	0.00	34.40
12	40.35	12.00	34	0.00	36.90
13	42.55	9.20	35	20.00	34.40
14	45.35	9.20	36	20.00	36.90
15	50.70	9.20	37	25.35	34.40
16	53.50	9.20	38	25.35	36.90
17	56.30	9.20	39	45.35	34.40
18	55.70	12.00	40	45.35	36.90
19	70.70	10.00	41	50.70	34.40
20	70.70	12.50	42	50.70	36.90
21	2.70	22.00	43	70.70	34.40
22	8.40	23.70	44	70.70	36.90

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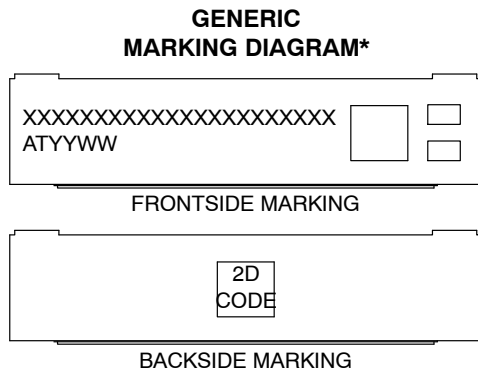
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

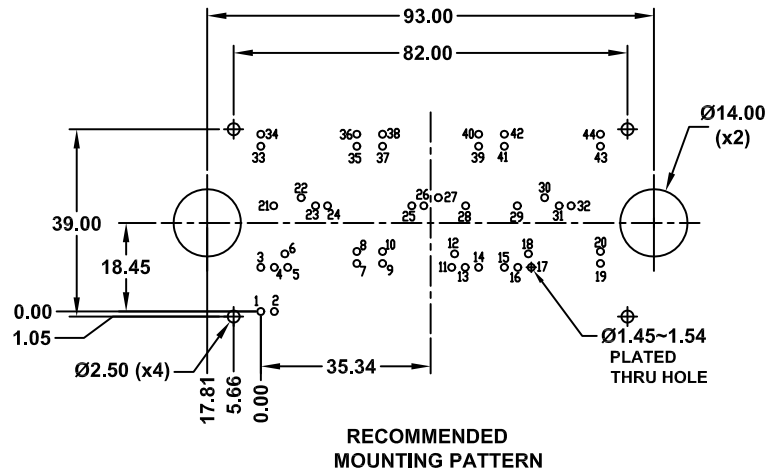


PIM44, 93x47 (PRESS FIT)  
CASE 180HF  
ISSUE O

DATE 26 OCT 2021



XXXXX = Specific Device Code  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code



\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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